

REFERENCE NO. OF DOCUMENT BEING CONTINUED: NNK11365214R1
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ATTACHMENT COVER PAGE

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METRIC

MIL-PRF-27401F
10 January 2008

SUPERSEDING
MIL-PRF-27401E
23 February 2007

PERFORMANCE SPECIFICATION

PROPELLANT PRESSURIZING AGENT, NITROGEN

This specification is approved for use by all Departments and Agencies of the Department of Defense.

Comments, suggestions, or questions on this document should be addressed to HQ-AFPET/AFTT, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB OH 45433-7632 or e-mailed to AFPET.AFTT@wpafb.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil>.

AMSC N/A

FSC 9135

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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1. SCOPE

1.1 Scope. This specification covers the requirements for three grades and two types of nitrogen.

1.2 Classification. The nitrogen will be of the following types and grades as specified (see 6.2).

1.2.1 Types. The types of nitrogen are as follows:

Type I - Gaseous

Type II - Liquid

1.2.2 Grades. The grades of nitrogen are as follows:

Grade A - 99.5 percent pure, aerospace practices

Grade B - 99.99 percent pure, space vehicle and cabin environment

Grade C - 99.995 percent pure, special applications

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specification forms a part of this document to the extent specified herein. Unless otherwise specified, the issue of this document is the one cited in the solicitation or contract (see 6.2).

COMMERCIAL ITEM DESCRIPTIONS

A-A-58092 Tape, Antiseize, Polytetrafluorethylene

(Copies of this document is available online at <http://assist.daps.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Bldg 4D, Philadelphia PA 19111-5094.)

2.3 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM E 29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
ASTM F 307	Standard Practice for Sampling Pressurized Gas for Gas Analysis
ASTM F 310	Standard Practice for Sampling Cryogenic Aerospace Fluids

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(Copies of these documents are available online at <http://www.astm.org> or by mail at ASTM International, 100 Barr Harbor Drive, West Conshohocken PA 19428-2959)

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-10.1	Commodity Specification for Nitrogen
CGA P-15	Filling of Industrial and Medical Nonflammable Compressed Gas Cylinders

(Copies of these documents are available online at <http://www.cganet.com> or by mail from the Compressed Gas Association, Inc., 4221 Walney Road, 5th floor, Chantilly, VA 20151-2923)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Grade requirements. The purity and impurity concentrations as applicable to each grade of nitrogen shall conform to the limits of Table I when tested in accordance with the applicable test method also specified in Table I. Other limits and tests may be specified by the procuring activity (see 6.2).

3.2 Limiting values. The following applies to all specified limits in this specification: For purposes of determining conformance with these requirements, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand digit used in expressing the specification limit according to the rounding-off method of ASTM E 29 Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications.

3.3 Filter.

3.3.1 Containers. A filter with a rating of at least 10-micrometer nominal and 40-micrometer absolute rating shall be installed between the manufacturer's plant system and the manifold used to fill the gas or liquid containers for delivery.

3.3.2 Pipelines. A filter with a rating of at least 3.5-micrometer nominal and 12-micrometer absolute rating shall be installed downstream of compressors and/or converters and as close to the user's interface as possible for delivery into pipelines. The filter shall remove all particles greater than 100 micrometers in any dimension.

3.4 Filled containers (Type I only).

3.4.1 Pressure. The filling pressure for tube trailers shall not differ from that required by the contract by more than 1% at 70°F when tested as specified in 4.5.1. Cylinders shall be filled to within 99 to 100 percent of their rated service pressure when tested as specified in 4.5.1. In no case shall the filling pressure exceed the rated service pressure of the container. Pressure-Temperature Filling Chart in CGA P-15 may be used.

3.4.2 Leakage. Containers shall not leak when tested according to 4.5.2.

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TABLE I. Grade limits for nitrogen.

	Grade			Test Method
	A	B	C	
Purity ^{a, b} , % by vol, min	99.5	99.99	99.995	4.4.1
Impurities, ppm by volume, max	5000	100	50	Note c
Water	26.3	11.5	5.7	4.4.2
Total hydrocarbons as methane	58.3	5.0	5.0	4.4.2
Oxygen	5000	50	20	4.4.2
Hydrogen	Note d	Note d	0.5	4.4.2
Argon ^e	Note d	20	2	4.4.2
Carbon dioxide ^e	Note d	5	5	4.4.2
Carbon monoxide ^e	Note d	5	5	4.4.2
Particulate ^f , mg/L, max	1.0	1.0	1.0	4.4.3
<p>Notes.</p> <p>a. Percent nitrogen includes trace quantities of neon, helium, and argon.</p> <p>b. If direct method is required, use the alternate method found in 6.3.</p> <p>c. Sum, in parts per million (ppm), of water, hydrocarbons, oxygen, and, if applicable hydrogen, carbon monoxide, and carbon dioxide.</p> <p>d. No limit for this grade.</p> <p>e. If required by contract (see 6.2).</p> <p>f. Applies only to Type II (Liquid) nitrogen. The particulate limit may be removed by the procuring activity (see 6.2).</p>				

4. VERIFICATION

4.1 Points of inspection (see 6.2).

4.1.1 Containers. Unless otherwise specified, acceptance tests shall be conducted at the site of filling prior to shipment or departure.

4.1.2 Pipeline. When Type I nitrogen is delivered in pipeline, acceptance tests shall be conducted immediately prior to entering the user's system.

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4.2 Conformance inspection. Quality conformance tests shall consist of the following:

- a. Individual tests (Type I only)..... 4.2.1
- b. Sampling tests 4.2.2

4.2.1 Individual tests (Type I only). Each container shall be subjected to the following tests as described under 4.5:

- a. Filling pressure 4.5.1
- b. Leakage 4.5.2

4.2.2 Sampling test. The number of nitrogen containers shall be selected in accordance with Table II and subjected to the tests required by Table I.

TABLE II. Sampling for test.

Number of containers in lot	Number of containers to be sampled
1	1
2 – 40	2
41 – 70	3
71 – over	4

4.2.3 Lot definitions.

4.2.3.1 Type I. A lot is defined as all of the nitrogen supplied in one or more container(s) filled from a single manifold at the same time.

4.2.3.2 Type II. Each filled container shall constitute a lot.

4.2.3.3 Container Assemblies. A shipping conveyance consisting of multiple cylinders or tubes that are interconnected by a single manifold that equalizes the pressure across all cylinders/tubes to form a single unit is considered a single container for the purpose of this specification.

4.2.4 Sample. Each sample shall be of sufficient size to conduct all the quality conformance tests as specified herein. Unless otherwise specified, the quality conformance tests shall be performed on each required sample (see 6.2). When required, an equivalent sample shall be forwarded to a laboratory designated by the procuring activity for testing.

4.2.4.1 Sampling methods. Each sample taken for analysis shall be representative of the entire contents of the container being sampled. All equipment used shall be made of suitable materials. Unless otherwise specified in the acquisition requirements (see 6.2), sampling shall be accomplished by one of the following methods.

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a. Type I, gaseous nitrogen may be sampled in accordance with ASTM F 307 and Type II, liquid nitrogen may be sampled in accordance with ASTM F 310. It is critical that the outlet of the sampling port be clean and free of contaminants.

b. Connect the shipping container being sampled directly to the analytical equipment using suitable pressure regulation as required to prevent over-pressurization of the equipment.

4.2.5 Non-Bulk Containers. Non-bulk containers are defined as containers of 400 liters or less water capacity. The number of containers filled with Type I (gaseous) nitrogen selected for sampling from each lot shall be in accordance with Table II. The first and last containers to be filled within a given lot are typically sampled. Other samples may be selected at random. Every container filled with Type II (liquid) nitrogen shall constitute a lot and will be sampled.

4.2.6 Bulk transports. Bulk containers are defined as containers of more than 400 liters water capacity. Each bulk container filled with Type I (gaseous) or Type II (liquid) nitrogen constitute a lot and shall be sampled.

4.2.6.1 Continuous service (see 6.6.1). Unless otherwise specified by the procuring activity, the following sample option for nitrogen shall be used for storage and transport tanks engaged in continuous nitrogen service (see 6.2). Contractor shall sample the contents of each transport tank engaged in continuous nitrogen service at least once every seven days at uniform intervals of time. Samples shall be taken from the filled transport tanks. Contractor shall sample the contents of each transport tank when entering continuous service and when the transport tank has remained empty for a period greater than 24 hours. When empty, all ports and vents shall remain closed to the atmosphere. While in continuous service, compliance with quality conformance tests specified herein shall be determined by sampling the filling point storage tank after each addition or, in case of continuous production, at established intervals not less frequent than once every 24 hours. When a storage tank is being filled during a change of duty shift, sampling shall be performed after filling.

4.2.7 Pipelines. Unless otherwise specified in the contract, the following sampling plan shall be used for pipelines: Sampling to determine specification compliance shall be accomplished by drawing liquid phase samples from each filled container transporting liquid for conversion to gas and by drawing samples from the gas supplied into the user's system (see 6.2).

4.2.7.1 Liquid phase samples. Liquid phase samples shall be tested for each parameter in applicable grade of Type II nitrogen. Sampling under the "continuous service" provisions can be applied.

4.2.7.2 Gas phase samples.

a. Samples shall be tested for each parameter in the applicable grade of Type I nitrogen. Samples shall be drawn in accordance with 4.2.4 from a point immediately prior to entering the user's system. The frequency of sampling shall not be less than once every seven days at regular intervals.

b. When specified in contract, in-line samples shall be drawn and tested with continuous monitors for each parameter specified in contract for the applicable grade of Type I nitrogen. Each analyzer shall be equipped with a permanent recording device. When specified in contract, an alarm system to indicate contaminant contents in excess of specified maximum shall be provided (see 6.2).

c. After internal exposure of the pipeline to the atmosphere or other foreign materials, a sample of gas shall be taken from the pipeline prior to delivery into the user's system at a point between the final filter and the interface with the Government system. The sample shall be tested for each parameter in applicable grade of Type I nitrogen. After cleaning operation, the sample shall also be tested for contamination by vapors from the cleaning materials.

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4.3 Rejection. When any sample tested in accordance with 4.4 fails to conform to the requirements specified herein, the entire lot represented by the sample shall be rejected.

4.4 Analytical procedures. Unless otherwise specified, samples shall be analyzed according to the procedures described in 4.4.2 (see 6.2). Calibration gas standards may be required to calibrate (zero and span) analytical instruments used to determine the purity and impurity contents of the nitrogen. The accuracy of the calibration gas standards is to be traceable to the National Institute of Standards and Technology.

4.4.1 Nitrogen content. The nitrogen content in percent shall be found by determining the aggregate impurities by the methods described in 4.4.2. The nitrogen purity is the value obtained when the aggregate impurities, expressed as volume percent, is subtracted from 100 percent.

4.4.2 Impurities. Methods shall be selected from those of CGA G-10.1.

4.4.3 Particulate content. A filter holder assembly, (Pall Life Sciences part number 2220), or equivalent modified as shown in Figure 1 shall be attached to the withdrawal line of the vessel to be utilized to fill the tanks. A preweighed filter paper (47 mm glass fiber paper, type A/E or equivalent) shall be placed on top of another filter of the same kind. The filters shall then be placed on the porous filter support, which, in turn, shall be placed in the filter holder as shown in Figure 1. The male threads of the filter holder shall be wrapped with thin, nonadhesive-backed polytetrafluorethylene tape A-A-58092 or equivalent to prevent galling of the threads. The holder shall be tightened by hand as tight as possible to prevent bypassing of the filter element. The discharge liquid from the filter housing shall be collected in a clean, uninsulated, ambient temperature vessel marked to indicate when 5 liters of liquid have been collected. The liquid flow shall be terminated when 5 liters of liquid have been collected. The filter holder shall be removed from the line and permitted to reach ambient temperature. The warmup to ambient temperature may be expedited by use of an oven or other heat source. Care shall be exercised to ensure that any airflow which enters the unit will be directed through the inlet of the assembly to prevent displacing any particles from the surface of the filter. Upon warmup, the other side of the holder shall be wiped with a clean cloth and the holder then disassembled. The filter paper shall be closely inspected. The test shall be repeated if evidence of either (a) the filter not being securely clamped by uniform depression of its edge; (b) the filter having been cut by the holder; or (c) when dirt particles are detected in the clamped area indicating bypassing had been encountered. The test shall also be repeated when either the bottom filter shows any discoloration or when leakage of liquid from the filter holder is detected. Upon completion of a valid test the filter shall be removed from the housing and weighed to the nearest 0.1 mg.

4.5 Containers of Type I nitrogen.

4.5.1 Filling pressure. Containers shall be tested for proper filling pressure by attaching a calibrated Bourdon-tube gauge or equivalent to the valve outlet and by attaching either a thermocouple or thermometer to the container wall. The gauge shall have scale divisions not greater than 100 kPa (15 psi). If a thermometer is used, tape or putty shall be applied to the bulb to protect it from extraneous temperatures. Putty shall not be applied between the bulb and the container wall. The thermometer shall have scale divisions not greater than 1°C (2°F). The containers shall be stabilized to ambient temperature. Then the valve shall be opened and the internal pressure observed on the gauge. If the internal pressure differs from the applicable pressure value by more than 100 kPa (15 psi), the container, and all other containers filled from the same manifold at the same time shall be rejected.

4.5.2 Leakage. Each Type I nitrogen container shall be tested for leaks at the neck threads, stem packing, and safety device of the valve with leak-detection fluid. Valve seat leakage shall be tested after filling has been completed by connecting a hose to the valve outlet and placing the other end of the hose under the surface of a liquid.

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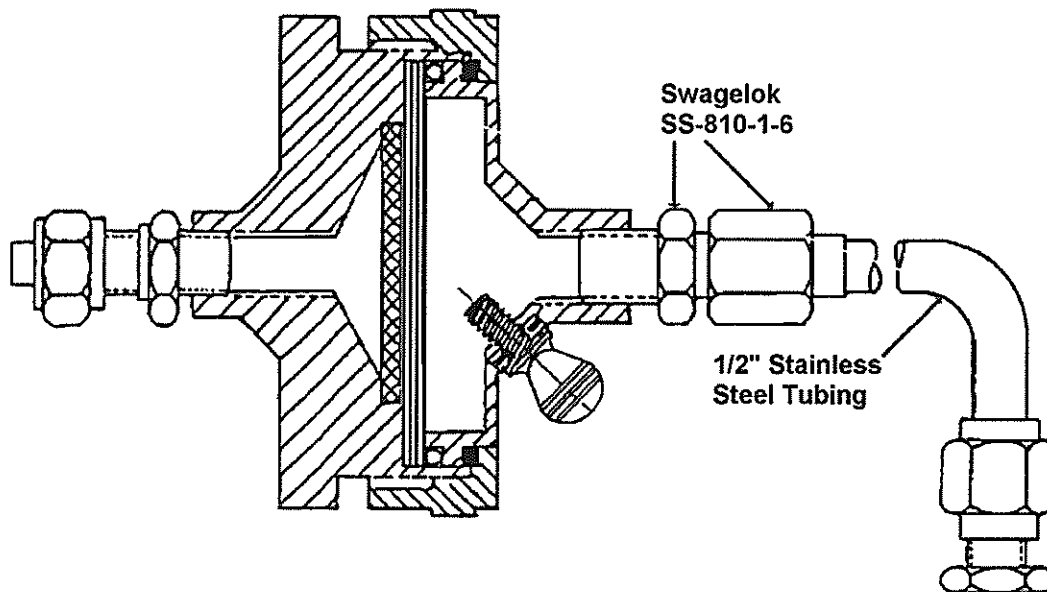


FIGURE 1. Filter, Cryogenic Liquids

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The nitrogen covered by this specification is intended as a purging and pressurizing medium for rocket propellant systems, space vehicles and support equipment and for preparing oxygen-nitrogen mixtures for breathing purposes on board space vehicles (see 1.2.2).

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6.2 Acquisition requirements. Acquisition documents must specify the following:

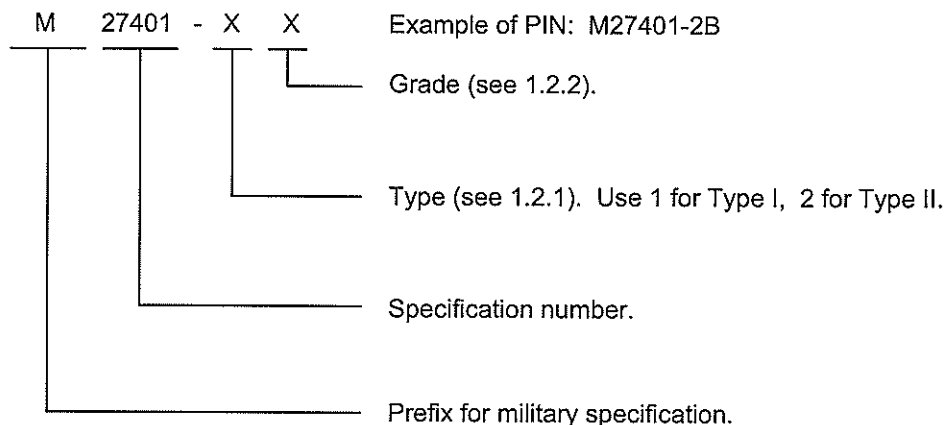
- a. Title, number, and date of this specification.
- b. Type and grade of nitrogen required (see 1.2).
- c. If required, the specific issue of individual documents referenced (see 2.2.1).
- d. When other limits or tests are required (see 3.1).
- e. When testing for argon, carbon dioxide, or carbon monoxide is required (see Table I, Note e).
- f. When the particulate test is not required (see Table I, Note f).
- g. When a variation in the points of inspection is required (see 4.1).
- h. When a variation of the quality conformance tests to be performed on a sample is required (see 4.2.4).
- i. When a variation to the sampling method is required (see 4.2.4.1).
- j. When a variation to the continuous service option is required (see 4.2.6.1).
- k. When a variation to the sampling plan for pipelines is required (see 4.2.7).
- l. When an alarm system to warn of contaminants in pipelines is required (see 4.2.7.2.b).
- m. When a variation of the analytical procedures is required (see 4.4).
- n. Packaging requirements (see 5.1).
- o. When color coding of pipeline is required (see 6.4.c).

6.3 Direct nitrogen method. When required one of the following methods shall be used to determine the nitrogen content directly. (1) The gas chromatographic method which uses a 5Å molecular sieve column and measures the peak height versus retention time. (2) The mass spectrometric method which measures nitrogen at an atomic mass unit (amu) of 28. Carbon monoxide also has an amu of 28 but it can be determined by other methods.

6.4 Packaging requirements. Guidance for cylinders may be found in the following documents:

- | | |
|---------------------|---|
| a. RR-C-901 | Cylinders, Compressed Gas: Seamless Shatterproof, High Pressure DOT 3AA Steel, and 3AL Aluminum |
| b. MIL-DTL-2/11 | Valve, Cylinder, Gas, Argon, Helium, Nitrogen, Neon, and Xenon, (Inert-Oil Free), Outlet 580 |
| c. MIL-STD-101 | Color Code for Pipelines and for Compressed Gas Cylinders |
| d. MIL-STD-1411 | Inspection and Maintenance of Compressed Gas Cylinders |
| e. 49 CFR 171 – 199 | Code of Federal Regulations |

6.5 Part or identifying number. The PINs to be used for nitrogen acquired to this specification are created as follows:



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6.6 Definition.

6.6.1 Continuous service. Continuous service applies to continuous deliveries under Government contract of nitrogen complying with the quality conformance tests specified herein.

6.7 Subject term (key word) listing.

Aerospace
Cryogenic
Cylinders
Pipeline
Space vehicle

6.8 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:

Army – MI
Navy – AS
Air Force – 68
DLA – PS

Preparing activity:

Air Force – 68
(Project 9135-2007-003)

Review activities:

Air Force – 19
Air Force – 11

Civil Agency:

NASA – NA

Note: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information using the ASSIST Online database at <http://assist.daps.dla.mil>.

METRIC

MIL-PRF-25508G

21 November 2006

SUPERSEDING

MIL-PRF-25508F

19 October 1995

PERFORMANCE SPECIFICATION

PROPELLANT, OXYGEN

This specification is approved for use by all Departments and Agencies of the Department of Defense.

Comments, suggestions, or questions on this document should be addressed to DET 3, WR-ALC/AFTT, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB OH 45433-7632 or e-mailed to AFPET.AFTT@wpafb.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil>.

AMSC N/A

FSC 9135

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

MIL-PRF-25508G

1. SCOPE

1.1 Scope. This specification covers the requirements for three grades and two types of oxygen.

1.2 Classification. The oxygen shall be of the following types and grades as specified (see 6.2).

1.2.1 Types. The types of oxygen are as follows:

Type I – Gaseous

Type II – Liquid

1.2.2 Grades. The grades of oxygen are as follows:

Grade A – 99.6 percent pure, standard

Grade B – 99.5 percent pure, reduced standard

Grade F – 99.990 percent pure, fuel cell and breathing

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following standard forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of this document are those cited in the solicitation or contract (see 6.2).

COMMERCIAL ITEM DESCRIPTION

A-A-58092

Tape, Antiseize, Polytetrafluorethylene

(Copies of this document is available online at <http://assist.daps.dla.mil/quicksearch/> or <http://assist.daps.dla.mil> or by mail from the Standardization Document Order Desk, 700 Robbins Avenue, Bldg 4D, Philadelphia PA 19111-5094.)

2.3 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

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ASTM INTERNATIONAL (ASTM)

ASTM E 29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
ASTM F 307	Standard Practice for Sampling Pressurized Gas for Gas Analysis
ASTM F 310	Standard Practice for Sampling Cryogenic Aerospace Fluids

(Copies of these documents are available online at <http://www.astm.org> or by mail from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA, 19428-2959)

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-4.3	Commodity Specification for Oxygen
CGA P-15	Filling of Industrial and Medical Nonflammable Compressed Gas Cylinders

(Copies of these documents are available online at <http://www.cganet.com> or by mail from the Compressed Gas Association, Inc., 4221 Walney Road, 5th floor, Chantilly, VA 20151-2923)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Grade requirements. The purity and impurity concentrations as applicable to each grade of oxygen shall conform to the limits of Table I when tested in accordance with the applicable test method also specified in Table I. Other limits and tests may be specified by the procuring activity (see 6.2).

3.2 Limiting values. The following applies to all specified limits in this specification. For purposes of determining conformance with these requirements, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand digit used in expressing the specification limit according to the rounding-off method of ASTM E 29 Standard Practice for using Significant Digits in Test Data to Determine Conformance with Specifications.

3.3 Filter. A filter with no more than a 10-micrometer nominal and 40-micrometer absolute rating shall be installed between the manufacturer's plant system and the manifold used to fill the gas or liquid containers for delivery.

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TABLE I. Grade limits for oxygen.

	Grade			Test Method
	A	B	F	
Purity, percent by volume, min	99.6	99.5	99.990	4.4.1
Impurities, ppm by volume, max	4000	5000	100	4.4.1
Total hydrocarbons as methane	50	67.7	20	4.4.2
Water	3	26.3	3	4.4.2
Methane	Note a	Note a	16	4.4.2
Ethane	Note a	Note a	2	4.4.2
Propane and higher hydrocarbons as propane	Note a	Note a	1	4.4.2
Nitrous oxide	Note a	Note a	1	4.4.2
Halogenated hydrocarbons	Note a	Note a	1	4.4.2
Carbon monoxide and carbon dioxide	Note a	Note a	1	4.4.2
Other (N, Ar, Kr, etc.)	Note a	Note a	75	4.4.2
Odor	Note a	Note a	None	4.4.2
Particulate ^b , mg/L, max	1.0	1.0	1.0	4.4.3
a. No limit for this grade. b. Applies to Type II product only. The particulate test requirement and limit may be deleted by the procuring activity (see 6.2).				

3.4 Filled containers (Type I only).

3.4.1 Filling Pressure. The container filling pressure shall not differ from that required by the contract by more than 1.0% at 70°F when tested as specified in 4.5.1. In no case shall the filling pressure exceed the rated service pressure of the container. Pressure-Temperature Filling Charts in CGA P-15 may be used.

3.4.2 Leakage. Cylinders shall not leak when tested according to 4.5.2.

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4. VERIFICATION

4.1 Points of inspection (see 6.2). Unless otherwise specified, acceptance tests shall be conducted at the site of filling prior to shipment or departure.

4.2 Conformance inspection. Quality conformance tests shall consist of the following:

- a. Individual tests (Type I only) 4.2.1
- b. Sampling tests 4.2.2

4.2.1 Individual tests (Type I only). Each container (cylinder or tube) shall be subjected to the following tests as described under 4.5.

- a. Filling pressure 4.5.1
- b. Leakage 4.5.2

4.2.2 Sampling test. The number of oxygen containers shall be selected in accordance with Table II and subjected to the tests required by Table I.

Table II. Sampling for test.

Number of containers in lot	Number of containers to be sampled
1	1
2 – 40	2
41 – 70	3
71 – over	4

4.2.3 Lot and Container Definitions

4.2.3.1 Lot: A lot shall be defined as one of the following

- a. All of the oxygen supplied in one or more containers filled from one manifold at the same time.
- b. All of the oxygen filled from a single storage tank that is homogenous at the time of withdrawal and is not added to while being withdrawn. After each addition to the storage tank, the contents shall constitute a separate lot.

4.2.3.2 Container: A container is defined as a shipping conveyance consisting of one cylinder or tube, or multiple cylinders or tubes that are interconnected by a single manifold that equalizes the pressure across all the cylinders or tubes to form one unit.

4.2.4 Sample. Each sample shall be of sufficient size to conduct all the quality conformance tests as specified herein. Unless otherwise specified, the quality conformance tests shall be performed on each required sample (see 6.2). When required, an equivalent sample shall be forwarded to a laboratory designated by the procuring activity for testing.

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4.2.4.1 Sampling methods. All apparatus used shall be made of suitable materials. Each sample taken for analysis shall be representative of the entire contents of the container being sampled. Unless otherwise specified in the acquisition requirements (see 6.2), sampling may be accomplished by the following methods.

a. Type I, gaseous oxygen may be sampled in accordance with ASTM F 307, for Type II, liquid oxygen may be sampled in accordance with ASTM F 310. It is critical that the outlet of the sampling port and the other equipment used in this process meet oxygen system cleanliness standards. Use an oxygen compatible cleaning solvent in accordance with local procedures for oxygen cleanliness.

b. By connecting the shipping container being sampled directly to the analytical equipment using suitable pressure regulation as required. It is critical that the outlet of the sampling port and the other equipment used in this process meet oxygen system cleanliness standards. Use an oxygen compatible cleaning solvent in accordance with local procedures for oxygen cleanliness.

4.2.5 Non-bulk Containers. Non bulk containers are defined as containers with a water capacity of 400 liters, or less. The number of non-bulk containers Type I (gaseous) or Type II (liquid) oxygen will be in accordance with Table II. Containers to be sampled may be selected at random.

4.2.6 Bulk Containers. Bulk containers are defined as having a water capacity in excess of 400 liters. Each bulk container filled with Type I (gaseous) and Type II (liquid) oxygen constitutes a lot and shall be sampled.

4.2.6.1 Continuous service. (see 6.4.1) Unless otherwise specified by the procuring activity, the following sample option for oxygen shall be used for storage and transport tanks engaged in continuous oxygen service (see 6.2). Contractor shall sample the contents of each transport tank engaged in continuous oxygen service at least once every seven days at uniform intervals of time. Samples shall be taken from the filled transport tanks. Contractor shall sample the contents of each transport tank when entering continuous service and when the transport tank has remained empty for a period greater than 24 hours. When empty, all ports and vents shall remain closed to the atmosphere. While in continuous service, compliance with quality conformance tests specified herein shall be determined by sampling the filling point storage tank after each addition or, in case of continuous production, at established intervals not less frequent than once every 24 hours. When a storage tank is being filled during a change of duty shift, sampling shall be performed after filling.

4.3 Rejection. When any sample tested in accordance with 4.4 fails to conform to the requirements specified herein, the entire lot represented by the sample shall be rejected.

4.4 Analytical procedures. Unless otherwise specified, samples shall be analyzed according to the procedures described below (see 6.2). Calibration gas standards may be required to calibrate (zero and span) analytical instruments used to determine the purity and impurity contents of the oxygen. The accuracy of the calibration gas standards is to be traceable to the National Institute of Standards and Technology (NIST). A suggested procedure for infrared analysis is provided in 6.7.

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4.4.1 Purity. Methods shall be selected from CGA G-4.3 except for grade F. The purity of grade F shall be determined by difference as follows:

$$\%O_2 = 100 - 10^4 \sum I$$

where $\sum I$ equals the sum of the water content, total hydrocarbons, nitrous oxide, carbon dioxide, carbon monoxide, and inert gases in ppm by volume.

4.4.2 Gaseous impurities. Methods shall be selected from those of CGA G-4.3.

4.4.3 Particulate content. A filter holder assembly (Pall Life Sciences part No. 2220) or equivalent, modified as shown in Figure 1, shall be attached to the withdrawal line of the vessel to be utilized to fill the tanks. A preweighed filter paper (47 mm glass fiber paper, type A/E or equivalent) shall be placed on top of another filter of the same kind. The filters shall then be placed on the porous filter support, which, in turn, shall be placed in the filter holder as shown in Figure 1. The male threads of the filter holder shall be wrapped with thin, nonadhesive-backed polytetrafluorethylene tape A-A-58092, or technical equivalent, to prevent galling of the threads. The holder shall be tightened by hand as tight as possible to prevent bypassing of the filter element. The discharge liquid from the filter housing shall be collected in a clean, uninsulated, ambient temperature vessel marked to indicate when 5 liters of liquid have been collected. The liquid flow shall be terminated when 5 liters of liquid have been collected. The filter holder shall be removed from the line and permitted to reach ambient temperature. The warmup to ambient temperature may be expedited by use of an oven or other heat source. Care shall be exercised to ensure that any airflow which enters the unit will be directed through the inlet of the assembly to prevent displacing and particles from the surface of the filter. Upon warmup, the other side of the holder shall be wiped with a clean cloth and the holder then disassembled. The filter paper shall be closely inspected. The test shall be repeated if evidence of either (a) the filter not being securely clamped by uniform depression of its edge; (b) the filter having been cut by the holder; or (c) when dirt particles are detected in the clamped area indicating bypassing had been encountered. The test shall also be repeated when either the bottom filter shows any discoloration or when leakage of liquid from the filter holder is detected. Upon completion of a valid test the filter shall be removed from the housing and weighed to the nearest 0.1 mg.

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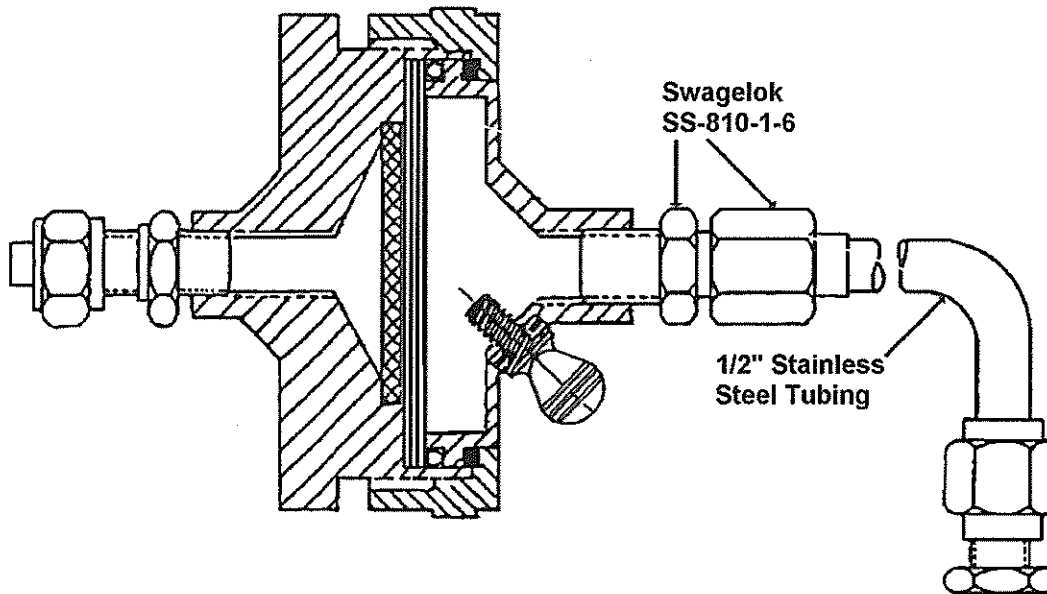


Figure 1. Filter Cryogenic Liquids

4.5 Containers of Type I oxygen.

4.5.1 Filling pressure. Containers shall be tested for proper filling pressure by attaching a calibrated Bourdon-tube gauge or equivalent to the valve outlet and by attaching either a thermocouple or thermometer to the container wall. The gauge shall have scale divisions not greater than 100 kPa (15 psi). If a thermometer is used, tape or putty shall be applied to the bulb to protect it from extraneous temperatures. Putty shall not be applied between the bulb and the container wall. The thermometer shall have scale divisions not greater than 1°C (2°F). The containers shall be stabilized to ambient temperature. The valve shall then be opened and the internal pressure observed on the gauge.

4.5.2 Leakage. Each Type I oxygen container shall be tested for leaks at the neck threads, stem packing, and safety device of the valve with leak-detection fluid. Valve seat leakage shall be tested by means of a tube from the valve outlet to a container of liquid.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The propellant covered by this specification is intended for use as follows.

- a. Grade A, type I – Purging and pressurization of propellant systems and rocket engines.
- b. Grade A, type II – Oxidizer.
- c. Grade B, type II - Oxidizer.
- d. Grade F, types I and II – Fuel cell grade that may be used for crew breathing in subsystems utilizing a common storage for both functions.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Type and grade of oxygen required (see 1.2).
- c. If required, the specific issue of individual documents referenced (see 2.2.1).
- d. When other limits or tests are required (see 3.1).
- e. When the particulate test is not required (see Table I).
- f. When a variation in the points of inspection is required (see 4.1).
- g. When a variation of the quality conformance tests to be performed on each sample is required (see 4.2.4).
- h. When a variation to the sampling method is required (see 4.2.4.2).
- i. When a variation to the continuous service option is required (see 4.2.6.1).
- j. When a variation to the 400 liter criteria for sampling is required (see 4.2.7).
- k. When a variation of the analytical procedures is required (see 4.4).
- l. Packaging requirements (see 5.1 and 6.3).

6.3 Packaging requirements. Guidance for cylinders may be found in the following documents.

- | | |
|-----------------|---|
| a. RR-C-901 | Cylinders, Compressed Gas: Seamless Shatterproof, High Pressure DOT 3AA Steel, and 3AL Aluminum |
| b. MIL-DTL-2/39 | Valve, Cylinder, Gas: Oxygen Outlet 540 |
| c. MIL-STD-101 | Color Code for Pipelines and for Compressed Gas Cylinders |

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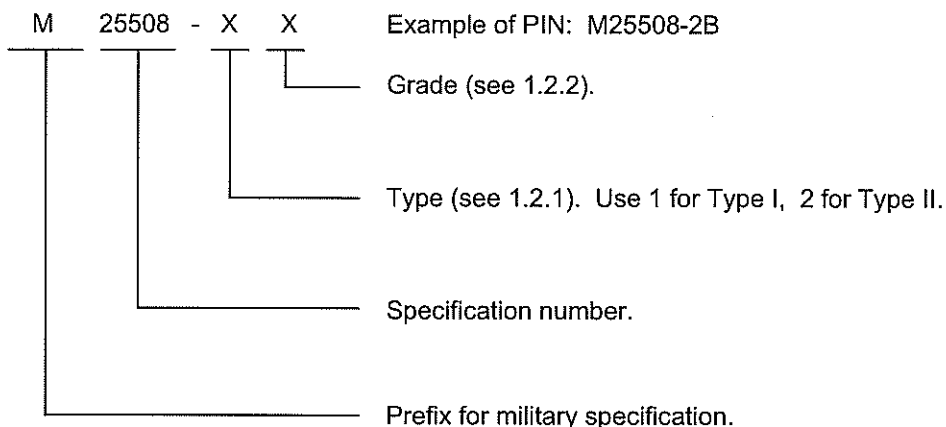
d. MIL-STD-1411 Inspection and Maintenance of Compressed Gas Cylinders

e. 49 CFR 171 – 199 Code of Federal Regulations

6.4 Definition.

6.4.1 Continuous service. Continuous service applies to continuous deliveries under Government contract of oxygen complying with the quality conformance tests specified herein.

6.5 Part or identifying number (PIN). The PIN's to be used for oxygen acquired to this specification are created as follows:



6.6 Subject term (key word) listing.

Aerospace
Breathing
Cryogenic
Cylinders
Fuel cell
Space vehicle

6.7 Infrared analysis. Procedures for calibration and analysis may be found in MIL-STD-1564, Procedure for Calibration and Analysis of Trace Contaminants in Aviator's Breathing Oxygen by Infrared Spectroscopy.

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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Custodians:

Army – MI
Navy – AS
Air Force – 68
DLA – PS

Preparing activity:

Air Force – 68
(Project 9135-2005-007)

Review activities:

Air Force – 19
DLIS – LS

Civil Agencies:

NASA

Note: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information using the ASSIST Online database at <http://assist.daps.dla.mil>.